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EXAMINER	
KIM, DAVID S	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 09/560,723	Applicant(s) WATANABE, SHIGEKI	
	Examiner David S. Kim	Art Unit 2613	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 20 February 2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1,3,6-9 and 12-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1,3,6-9 and 12-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 1, 3, 9, 12-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 ("All-optical fiber signal processing and regeneration for soliton communications", hereinafter "Bigo 10/97"), with reference to Alfano et al. (U.S. Patent No. 5,323,260, hereinafter "Alfano"), Ramaswami et al. (*Optical Networks: A Practical Perspective*, hereinafter "Ramaswami"), Smith et al. ("All-optical clock recovery using a mode-locked laser", hereinafter "Smith 9/92"), and Ellis et al. ("All optical clock recovery at bit rates up to 40 Gbit/s", hereinafter "Ellis"). See MPEP 2131.01 for information on the application of multiple references for 102-type treatment of claims.

Regarding claim 1, Bigo 10/97 discloses:

An optical apparatus (Fig. 9) comprising:

an optical path (path from data input to clock output in Fig. 9) provided between an input port (data input in Fig. 9), which is connected to a first optical fiber (waveguide input into Fig. 9 is conventionally an optical fiber), and to which signal light modulated at a frequency f_s (p. 1215, col. 1, 2nd paragraph) is supplied, and an output port (clock output in Fig. 9); and

an optical loop (loop in Fig. 9) optically coupled to said optical path;

said optical loop including:

an optical amplifier (EDFA in loop in Fig. 9) for compensating for a loss in said optical loop so that laser oscillation of a continuous wave having a wavelength λ_c (λ_c in Fig. 9) occurs in said optical loop;

an adjuster (optical delay line in Fig. 9, p. 1215, col. 1, 1st paragraph) for adjusting an optical path length of said optical loop so that said frequency f_s becomes equal to an integral multiple of the reciprocal of a recirculation period of said optical loop;

an optical bandpass filter (filter in loop in Fig. 9) that allows light having said wavelength λ_c only to pass; and

a nonlinear optical medium (p. 1214, col. 2, last paragraph – p. 1215, col. 1, 1st paragraph) for mode-locking said laser oscillation according to said signal light,

wherein said nonlinear optical medium performs modulation (p. 1220, col. 2, last paragraph) of said continuous wave by said signal light to obtain modulated CW (note that said modulation by said nonlinear optical medium is performed on said continuous wave, which would result in modulated CW, or continuous wave, light) light having said wavelength λ_c and including a component of said frequency f_s (Fig. 9, note that the light of wavelength λ_c has the same 20 Gb/s / 20 GHz frequency component as the input signal light), and

wherein pulses including said wavelength λ_c are generated by said nonlinear optical medium and output through the output port (λ_c clock output in Fig. 9), and a wavelength λ_s of said signal light of said input port is different from said wavelength λ_c of said continuous wave (signal light wavelength of 1555 nm is different from clock wavelength of 1548 nm on p. 1215, col. 1, 1st full paragraph).

Bigo 10/97 does not expressly disclose:

wherein said nonlinear optical medium includes a second optical fiber to which said signal light of said input port is inputted from said optical loop, and said continuous wave having said wavelength λ_c is inputted from said optical loop, and

said nonlinear optical medium performs said ***amplitude modulation by four-wave mixing using said signal light as pump light.***

However, notice that Bigo 10/97 teaches that the nonlinear optical medium may be embodied by a variety of intracavity modulators (p. 1215, col. 1, end of 1st paragraph). One of these choices is a Kerr fiber modulator (KFM), which comprises an optical fiber. In such an embodiment, the apparatus of Bigo 10/97 would comprise the "second optical fiber" limitation above. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ such an embodiment in the

apparatus of Bigo 10/97. One of ordinary skill in the art would have been motivated to do this since KFM's have the potential for use with high amounts of bandwidth (p. 1215, col. 1, end of 1st paragraph).

Regarding the "amplitude modulation" limitation above, Bigo 10/97 is silent about such amplitude modulation. However, notice that a KFM performs at least one form of modulation, cross-phase modulation (XPM) (Bigo 10/97, p. 1209, col. 1, last paragraph). Additionally, it is known that XPM may be accompanied by four-wave mixing (FWM) (Alfano, col. 4, l. 19-21), which provides amplitude modulation (Alfano, col. 4, l. 67 – col. 5, l. 2). The existence and/or strength of this FWM is based on the degree of phase matching between the interacting optical signals (Alfano, col. 5, l. 2-17; Ramaswami, p. 72, 2nd full paragraph). One situation that results in significant phase matching is when the interacting optical signals have wavelengths that are near the dispersion zero of an optical fiber (Ramaswami, p. 72, 2nd full paragraph).

So, the pertinent question to answer here is, "Would such FWM and amplitude modulation occur in the apparatus of Bigo 10/97?" In view of the prior art, the answer appears to be, "Yes." Notice that Bigo 10/97 refers to the KFM embodiments in Smith 9/92 and Ellis (Bigo 10/97, p. 1215, col. 1, end of 1st paragraph). These KFM embodiments both employ interacting optical signals with wavelengths that are near the dispersion zero of optical fibers (Smith 9/92, p. 1815, col. 2, 1st paragraph; Ellis, p. 1323, col. 1, last paragraph – p. 1324, col. 1). In view of Smith 9/92 and Ellis, it appears that the apparatus of Bigo 10/97 with a KFM would employ interacting optical signals with wavelengths that are near the dispersion zero of an optical fiber. Such a situation would result in significant phase matching, and such phase matching would result in the FWM and amplitude modulation described above. Accordingly, such an apparatus of Bigo 10/97 would read on the "amplitude modulation" limitation and the "amplitude-modulated CW light" limitation above.

Additionally, notice the remarkable similarities between the structure and operational details of Bigo 10/97 (e.g., Fig. 9 in view of the prior art and argument presented above) and Applicant's invention (e.g., Fig. 1). Such similarities strongly suggest that the apparatus of Bigo 10/97 (in view of the prior art and argument presented above) is substantially identical to Applicant's invention. This kind of situation is similar to MPEP 2112.01, section I. At first glance, it may appear that Applicant's invention differs from

Bigo 10/97 since Applicant's focuses on FWM and its related amplitude modulation while Bigo 10/97 is silent about FWM. However, in view of the prior art and argument presented above, it appears that FWM and its related amplitude modulation would occur in the apparatus of Bigo 10/97 (with a KFM embodiment).

Regarding claim 3, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising an optical coupler (50/50 coupler in Fig. 9) for optically coupling said optical path and said optical loop, said optical coupler providing a part of said optical path and a part of said optical loop.

Regarding claim 9, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising an input optical amplifier (EDFA connected to data input in Fig. 9) optically connected to said input port for amplifying said signal light.

Regarding claim 12, Bigo 10/97, as applied to claim 1 above, discloses:

An optical apparatus according to claim 1, further comprising a waveform shaper (NOLM in Fig. 11) optically connected to said output port for performing waveform shaping of said signal light according to an optical clock output from said output port.

Regarding claim 13, Bigo 10/97, as applied to claim 12 above, discloses:

An optical apparatus according to claim 12, wherein said waveform shaper comprises a nonlinear optical loop mirror (NOLM in Fig. 11).

Regarding claim 14, claim 14 is a system claim that corresponds largely to the apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding means in system claim 14. Claim 14 also includes a limitation absent from claim 1. This limitation is:

a first optical fiber for transmitting signal light modulated at a frequency f_s; and

the second optical fiber included in the optical loop.

Bigo 10/97, as applied to claim 1, also discloses such a first optical fiber (line input to "1:2 clock recovery" unit in Fig. 11 is conventionally an optical fiber) and the second fiber optical fiber included in the optical loop (fiber ring in Fig. 9).

Regarding claims 15-16, claims 15-16 are system claims that correspond largely to the apparatus claims 12-13, respectively. Therefore, the recited means in apparatus claims 12-13 read on the corresponding means in system claims 15-16. Claims 15-16 also include limitations absent from claims 12-13. These limitations are also disclosed by Bigo 10/97:

an optical fiber transmission line (optical fiber link on p. 1216, col. 1, last paragraph; input fiber transmission line to Fig. 11) for transmitting signal light; and

at least one optical repeater (regenerator stage on p. 1216, col. 2, 1st paragraph; e.g., Fig. 11) arranged along said optical fiber transmission line;

each of said at least one optical repeater comprising:

an optical clock regenerator (Fig. 9., p. 1216, col. 2, 1st paragraph) for regenerating an optical clock by mode locking of laser oscillation according to said signal light.

Regarding claim 17, claim 17 is a method claim that corresponds to apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding steps in method claim 17.

3. **Claims 6 and 8** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97, as applied to claim 1 above, with further reference to Greer et al. ("All-optical FM mode-locking of fibre laser", hereinafter "Greer"). See MPEP 2131.01 for information on the application of multiple references for 102-type treatment of claims.

Regarding claim 6, Bigo 10/97 refers to Smith 9/92 and Ellis, both of which refer to Greer, discloses:

An optical apparatus according to claim 1, wherein said nonlinear optical medium comprises a single-mode fiber (Greer, p. 1741, col. 1, last paragraph).

Regarding claim 8, Bigo 10/97, in view of the cited prior art above, discloses:

An optical apparatus according to claim 6, wherein said nonlinear optical medium has a zero dispersion wavelength substantially equal to the wavelength of said signal light (notice proximity of zero dispersion wavelength and wavelength of signal light in Smith 9/92, p. 1815, col. 2, 1st paragraph, Ellis, p. 1323, col. 2, last paragraph – p. 1324, col. 1, Greer, p. 1742).

4. **Claims 7 and 18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97, as applied to claim 1 above, further in view of Smith (U.S. Patent No. 5,548,433, hereinafter "Smith '433").

Regarding claim 7, Bigo 10/97, as applied to claim 1 above, discloses:

An optical device according to claim 1, wherein said nonlinear optical medium comprises a dispersion shifted fiber (notice that the dispersion zero of the fibers in Smith 9/92 and Ellis are near 1550 nm, which is characteristic of DSF, as standard single-mode fiber has the dispersion zero around 1310 nm, Ramaswami, p. 229).

Bigo 10/97, as applied to claim 1 above, does not expressly disclose:

said dispersion shifted fiber is ***highly nonlinear***.

Smith '433 teaches such a nonlinear optical medium (col. 9, l. 18-21). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate a highly nonlinear dispersion shifted fiber as the nonlinear optical medium of Bigo 10/97, as applied to claim 1 above. One of ordinary skill in the art would have been motivated to do this since doing so would enable one to practice the optical device of Bigo 10/97, as applied to claim 1 above, with shorter cavity lengths (col. 9, l. 11-12), providing advantages regarding lock-up time (col. 9, l. 11-12) and an obviously more compact optical device.

Regarding claim 18, Bigo 10/97, as applied to claim 7 above, further in view of Smith '433, discloses:

An optical device according to claim 7, wherein said nonlinear optical medium has a zero-dispersion wavelength substantially equal to the wavelength of said signal light (notice proximity of zero dispersion wavelength and wavelength of signal light in Smith 9/92, p. 1815, col. 2, 1st paragraph, Ellis, p. 1323, col. 2, last paragraph – p. 1324, col. 1).

5. **Claims 19-20** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 in view of Smith, as applied to claim 7 above, and further in view of Watanabe (WO98/08138, but Examiner references the English translation in U.S. Patent No. 6,307,984 B1).

Regarding claims 19-20, Bigo 10/97 in view of Smith discloses:

An optical device according to claim 1, wherein said second optical fiber comprises a highly-nonlinear dispersion shifted fiber (see treatment of claim 7 above).

However, Bigo 10/97 in view of Smith does not expressly disclose:

(claim 19) a nonlinear refractive index of said second optical fiber is equal to or larger than 5×10^{-20} m^2/W.

(claim 20) a mode field diameter of said second optical fiber corresponding to an effective core area is equal to or less than 4 μm.

However, first of all, Applicant does not appear to characterize these parameter values as inventive or effective to provide patentably unexpected results (Applicant's specification, p. 12-13, bridging paragraph). Rather, Applicant discusses them as exemplary parameter values for highly-nonlinear dispersion shifted fiber.

Additionally, these parameters are known values of highly-nonlinear dispersion shifted fiber, as shown by Watanabe (col. 24, l. 34-52) as part of a discussion of how to increase the nonlinear coefficient. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ these parameter values in the apparatus of Bigo 10/97 in view of Smith. One of ordinary skill in the art would have been motivated to do this since Bigo 10/97 in view of Smith is relatively silent about an exemplary nonlinear refractive index and an exemplary mode field diameter of said second fiber; Watanabe's teachings speak into this silence by providing structural details and techniques (col. 24, l. 34-52) for proper implementation of the apparatus by one of ordinary skill in the art.

Response to Arguments

6. Applicant's arguments filed on 20 February 2007 have been fully considered but they are not persuasive. Applicant presents four salient points.

Regarding the first point, Applicant states:

> "Alfano discloses that 'XMP can be accompanied by degenerate four wave mixing (DFWM) which results in amplification of the probe pulses' (see col. 4, lines 19-21 of Alfano) and 'two light pulses with the same frequency but different polarizations and intensities interact in condensed matter in a manner such as to produce compression and amplification of the weaker pulse' (see col. 4, lines 22-26.) That is, Alfano's pump pulse 50-3 and probe pulses 50-1, 50-2 (see, for example FIG. 4 of Alfano) are generated based on output of laser 13, and both pulses have the

> same wavelength. Accordingly, Alfano fails to teach or suggest the features recited in amended claim 1. Alfano fails to disclose a probe light having a wavelength different from the signal light" (Remarks, p. 7-8, bridging paragraph).

Examiner respectfully notes that, first of all, the standing rejection does not rely on Alfano's apparatus. Rather, the standing rejection relies on Alfano as a reference to show what physical effects one would expect in the apparatus of Bigo 10/97. Accordingly, the standing rejection does not incorporate Alfano's laser 13. Secondly, Alfano does consider XPM with different wavelengths/frequencies (col. 5, l. 10-12). Thus, Applicant's first point is not persuasive.

Regarding the second point, Applicant states:

> "Bigo's semiconductor optical amplifier (SOA), to which a 20 gb/s pseudo-random binary sequence (PRBS) signal is injected, outputs a clock pulse having a wavelength which is different from the PRBS signal. Therefore, applicants believe that Bigo's SOA cannot be replaced with Alfano's polarizer 59 with a probe pulse 50-3 and pump pulses 50-1 and 50-2. Therefore, amended claim 1 is not rendered obvious over Bigo in view of Alfano, Ramaswami, Smith, and Ellis" (Remarks, p. 8, 1st full paragraph).

Similar to above, Examiner respectfully notes that the standing rejection does not rely on Alfano's apparatus. Rather, the standing rejection relies on Alfano as a reference to show what physical effects one would expect in the apparatus of Bigo 10/97. Accordingly, the standing rejection does not incorporate Alfano's "polarizer 59 with a probe pulse 50-3 and pump pulses 50-1 and 50-2". Thus, Applicant's second point is not persuasive.

Regarding the third point, Applicant states:

> "In the Office Action it is submitted that Bigo does not discloses the 'amplitude modulation,' but it is asserted that 'KFM performs at least one form of modulation, cross-phase modulation (XPM).' See the last three lines on page 3 of the outstanding Office Action. Further, a chain of statements invoking two other references allegedly builds the argument for the obviousness of the 'amplitude modulated CW light' as recited in claim 1. Applicant strongly disagrees because only by impermissible hindsight reconstruction would one of ordinary skill at the time of the invention have combined the four-wave mixing that MAY occur besides the XPM in Alfano with ONE SITUATION that would result in phase matching according to Ramaswami. *In re Rouffet*, 149 F.3d 1350 sets forth criteria for being certain that impermissible hindsight is not being used to deprecate an invention.
>
>> To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner **to show** a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, **confronted with the same problems as the inventor and with no knowledge of the claimed invention**, would select the elements from the cited prior art references for combination in the manner claimed. [emphasis added]

> Applicant respectfully submit that the chain of statements and assertion pick and choose feature and elements of prior art references without providing any motivation for the combination" (Remarks, p. 8, last full paragraph – p. 9, 1st full paragraph, emphasis Applicant's).

Examiner respectfully notes that the standing rejection does not rely on an obviousness argument for incorporating the particular limitation of "amplitude modulated CW light", per se. Rather, the standing rejection relies on the references of Alfano, Ramaswami, Smith, and Ellis to show that the apparatus of Bigo 10/97 *with a KFM* would already include "amplitude modulated CW light". Thus, Applicant's third point is not persuasive.

Regarding the fourth point, Applicant states:

> "Additionally, Alfano discloses:
>
> • 'XPM can be accompanied by degenerate four-wave mixing (DFWM) which results in amplification of the probe pulses,' in col. 4, lines 19-21
>
> • 'two light pulses with the same frequency but different polarization and intensities interact in condensed matter in a manner such as to produce compression and amplification of the weaker pulse,' and
>
> • '[the] last term in Eqs. (2a) or (2b) is the degenerate four-wave mixing (DFWM), which modulates the amplitude as well as the phase,' in col. 4, line 67 to col. 5, line 2.
>
> However, the amplitude modulation of Alfano is **a modulation of a probe pulse by pump pulse**, which is not a continuous wave. The probe pulse and the pump pulse according to Alfano must have same frequencies but different polarizations and intensities. Therefore, the four-wave mixing to perform amplitude modulation of continuous wave by a signal light, as recited in claim 1. The probe pulse in Alfano cannot be replaced with a continuous wave because this replacement would be contrary to the stated goal of Alfano, which is compressing and amplifying a probe pulse using XPM and DFWM, which is different from the optical device recited in claim 1" (Remarks, p. 9, emphasis Applicant's).

Similar to above, Examiner respectfully notes that the standing rejection does not rely on Alfano's apparatus. Rather, the standing rejection relies on Alfano as a reference to show what physical effects one would expect in the apparatus of Bigo 10/97. Accordingly, the standing rejection does not incorporate Alfano's probe pulses. Thus, Applicant's fourth point is not persuasive.

Summarily, Applicant's arguments are not persuasive. Accordingly, Examiner respectfully maintains the standing rejections.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Kim whose telephone number is 571-272-3033. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth N. Vanderpuye can be reached on 571-272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

DSK

KENNETH VANDERPUYE
SUPERVISORY PATENT EXAMINER